

REMARKS

The Office Action dated October 26, 2004, has been received and reviewed.

Claims 1-4, 7-11, 14-16, and 20-32 are currently pending and under consideration in the above-referenced application, each standing rejected.

Reconsideration of the above-referenced application is respectfully requested.

35 U.S.C. § 112 Claim Rejections

Claims 1, 7, and 14 stand rejected under 35 U.S.C. § 112, second paragraph, for reciting subject matter which is purportedly indefinite. Specifically, each of these claims has been rejected for reciting the term “gradually,” as it applies to the acceleration of the rate at which a substrate is spun during spin coating processes.

With respect to determining whether relative terms, such as “gradually” are definite, M.P.E.P. § 2173.05(b) provides the following instructions:

When a term of degree is presented in a claim, first a determination is made as to whether the specification provides some standard for measuring that degree. If it does not, a determination is made as to whether one of ordinary skill in the art, in view of the prior art and the status of the art, would be nevertheless reasonably apprised of the scope of the invention.

In view of these instructions, it is clear that even if the specification of the above-referenced application does not provide guidance as to the meaning of the term “gradual,” a determination can still be made as to whether one of ordinary skill in the art would nevertheless be reasonably apprised of the scope of the invention.

While the Examiner has concluded that the specification of the above-referenced application does not provide some standard for measuring the degree of the relative term “gradually,” when used to describe rates at which spinning of a substrate is increased or decreased, the Examiner has grossly underestimated the understanding of those of ordinary skill in the art.

The third edition of the American Heritage College Dictionary defines the term “gradual” as “[a]dvancing or progressing by regular or continuous degrees.” In view of this definition, it is respectfully submitted that the term “gradually” is a relative term, which is acceptable if one of

ordinary skill in the art would readily understand its meaning in light of the specification.

See M.P.E.P. § 2173.05(b).

Turning now to references in the appropriate art, use of the term “gradual” in claims 1, 7, and 14 becomes even clearer. As an ancillary matter, one of ordinary skill in the art would readily understand that the term “deceleration” is merely negative acceleration. In fact, the Examiner has kindly provided a few pages from the text Serway, *Physics for Scientists and Engineers*, pages 30-32 (Saunders College Publishing), which carefully explains this simple concept: “[w]hen the velocity of particle changes with time, the particle is said to be *accelerating*. For example, . . . [a] car will slow down when you apply the brakes.” Thus, the specification of the above-referenced application clearly provides examples of “gradual” acceleration.

Conventionally, the acceleration of wafers during spin coating processes have been performed “as quickly as is practical to the final spin speed.” Wolf, Stanley, *Silicon Processing for the VLSI Era*, Volume 1: Process Technology, page 431 (1984) (hereinafter “Wolf”). This is because “[h]igh ramping rates have been shown to yield better film uniformities than low ramping rates.” *Id.* U.S. Patent 6,117,486 to Yoshihara (hereinafter “Yoshihara”), on which the Office relies for several of the claim rejections that have been presented in the above-referenced application, notes that in conventional spin coating processes, rotational acceleration may be effected at a rate of about 10,000 rpm/sec. Col. 10, lines 16-52. Thus, it would be reasonable for one of ordinary skill in the art to understand that an acceleration rate of 10,000 rpm/sec. is “as quickly as is practical.” While Yoshihara and Wolf both teach that even faster acceleration rates may be desirable (Yoshihara, col. 12, line 54, to col. 13, line 15; Yoshihara, col. 14, lines 28-42; Wolf, page 431) and Yoshihara characterizes an acceleration rate 30,000 rpm/sec. as “drastic,” these teachings do not diminish the fact that a conventional 10,000 rpm/sec. rate of acceleration still falls within the “as quickly as is practical” category and, thus, would not be considered “gradual” by one of ordinary skill in the art.

Wolf refers to lower-than-conventional rates of acceleration as “low ramping rates,” and notes that such acceleration rates are undesirable because they allow solvent in the resist to evaporate, leading to thickness nonuniformity. Wolf, page 431.

By way of contrast to accelerating or decelerating spinning of a substrate “as quickly as practical,” another reference, U.S. Patent 6,251,487 to Yonaha (hereinafter “Yonaha”), provides a nonlimiting example of “gradual” acceleration. Yonaha, at col. 7, lines 53-64, indicates that an increase of 4,670 rpm (from 1,000 rpm to 5,670 rpm) in the spin rate of a substrate may be effected over a period of two seconds, amounting to an acceleration of 2,335 rpm/sec. Notably, such gradual acceleration is only mentioned by Yonaha in reference to the change between an initial spin speed and an immediately subsequent spin speed. All of the other changes in the rate at which the substrate is rotated lack any reference to a rate of acceleration and, thus, must be assumed to be about “as quickly as practical.” A copy of Yonaha has already been provided to the Office.

In view of the foregoing, it is evident that “as quickly as practical” includes nearly instantaneous rates of acceleration (*e.g.*, 10,000 rpm/sec, 20,000 rpm/sec, 30,000 rpm/sec, etc.), while “gradual” rates of acceleration (*e.g.*, 2,335 rpm/sec) are not “as quickly as practical.”

It is, therefore, respectfully submitted that the meaning of the term “gradual,” as it applies to acceleration of the rate at which a substrate is rotated, or spun, would be readily apparent to one of ordinary skill in the art of spin coating. Accordingly, it is respectfully submitted that each of claims 1, 7, and 14 complies with the requirements of the second paragraph of 35 U.S.C. § 112 and, thus, that each of these claims is in condition for allowance.

Accordingly, withdrawal of the 35 U.S.C. § 112, second paragraph, rejections of claims 1, 7, and 14 is respectfully requested.

Rejections Under 35 U.S.C. § 102

Claims 1-4 stand rejected under 35 U.S.C. § 102(a) for reciting subject matter which is purportedly anticipated by that described in Yoshihara.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single reference which qualifies as prior art under 35 U.S.C. § 102. *Verdegaal Brothers v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Yoshihara describes a resist coating method. Resist is applied to a substrate as the substrate is being rotated. The rate at which the substrate is rotated is then decreased for a predetermined period of time. Thereafter, the rate at which the substrate is rotated is again increased. Yoshihara teaches that by spinning a semiconductor wafer at high speeds, lowering the speed for a time, and re-increasing its rotational speed, the wafer can be coated with material in such a way that circular ripples do not appear thereon.

As indicated in the tables of columns 9 and 10 of Yoshihara, the acceleration and deceleration between different spinning speeds are effected nearly instantaneously—at least 10,000 rpm/sec. For example, when the rate of spinning is decreased from 4,500 rpm to 2,000 rpm, at an acceleration rate of 30,000 rpm/sec, as disclosed at col. 9, lines 55-62, and col. 10, lines 8-10 of Yoshihara, deceleration would be effected for less than one-tenth of a second.

It is respectfully submitted that Yoshihara does not anticipate “gradually increasing a rate of . . . spinning,” as recited in independent claim 1.

The acceleration disclosed in Yoshihara is not gradual, as required by independent claim 1. Rather, as indicated in the tables of columns 9 and 10 of Yoshihara, the acceleration between different spinning speeds is nearly instantaneous—at least 10,000 rpm/sec. When a substrate is rotated at speeds that vary from about 0 rpm to about 4,500 rpm, a 10,000 rpm/sec or greater (*e.g.*, 30,000 rpm/sec) acceleration of the rotational speed of the substrate would not be gradual.

It is, therefore, respectfully submitted that, under 35 U.S.C. § 102(b), independent claim 1 is allowable over Yoshihara.

Claims 2-4 are each allowable, among other reasons, for depending from claim 1, which is allowable.

Claim 2 is further allowable since Yoshihara lacks any express or inherent description that recesses in the substrate are substantially filled as the substrate is spun at a first speed. Instead, the disclosure of Yoshihara is limited to processes for reducing or eliminating the occurrence of ripples over the surface of a layer of material that has been applied to a substrate by spin coating processes.

Claim 3 is additionally allowance since Yoshihara neither expressly nor inherently describes that, as a rate at which a substrate is spun is decreased to a second speed, material located within recesses of the substrate is permitted to set. Again, the description of Yoshihara is limited to spin coating processes which reduce or eliminate the occurrence of ripples on the surface of a material (*e.g.*, photoresist) layer.

For this reason, withdrawal of the 35 U.S.C. § 102(a) rejections of claim 1-4 is respectfully requested.

Rejections Under 35 U.S.C. § 103(a)

Claims 1-4, 7-11, 14-16, and 20-32 stand rejected under 35 U.S.C. § 103(a) for reciting subject matter which is allegedly unpatentable over the subject matter taught in Yoshihara, in view of teachings from U.S. Patent 5,405,813 to Rodrigues (hereinafter “Rodrigues”) and Wolf.

The standard for establishing and maintaining a rejection under 35 U.S.C. § 103(a) is set forth in M.P.E.P. § 706.02(j), which provides:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant’s disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

The teachings of Yoshihara have been summarized above.

Rodrigues teaches a method which includes spinning a semiconductor wafer at a first speed, decreasing a rate at which the wafer is spun to a second speed, applying photoresist to the substrate while “concurrently decelerat[ing the rate of spinning the wafer] from the first rotational speed to [the] second rotational speed” (col. 2, line 65, to col. 3, line 5; col. 5, lines 22-47), then increasing the rate at which the wafer is spun to a third speed and further increasing the rate at which the wafer is spun to a fourth speed.

As Rodrigues teaches that photoresist is applied “at a very slow dispense rate” to a semiconductor wafer “during [constant] deceleration of the semiconductor wafer” from a first speed to a second speed (col. 2, line 65, to col. 3, line 5; col. 4, lines 63-68), Rodrigues does not teach or suggest that material is applied to or located on the wafer as the wafer is spun at the first speed. Nor does Rodrigues teach or suggest maintaining the second rotational speed of the wafer once the material has been applied thereto and the second rotational speed has been reached. The teachings of Rodrigues are limited to applying resist to a wafer “*during deceleration of the . . . wafer*” *from a first speed to a second speed*. Col. 2, line 65, to col. 3, line 5 (emphasis supplied); *see also* col. 5, lines 22-47. As noted at col. 4, lines 63-68, photoresist is applied “at a very slow dispense rate” as the rate of rotation of a semiconductor wafer “is *constantly* decelerating from a very high speed to a very slow speed” (emphasis supplied). Due to this combination of teachings, it is clear that photoresist is not dispensed at a “substantially constant first speed” but, rather, over an infinite plurality of constantly decreasing speeds.

Wolf has been relied upon for its teaching of “static dispense” processes at page 431. Wolf teaches that in a “static dispense,” resist is dispensed onto a wafer while the wafer is *stationary*. Wolf also teaches that static dispense techniques are more desirable than “dynamic dispense” techniques, in which resist is applied while the wafer is *rotating*.

It is respectfully submitted that the teachings of Yoshihara, Rodrigues, or Wolf, taken individually or collectively, do not support a *prima facie* case of obviousness against any of claims 1-4, 7-11, 14-16, or 20-32.

First, it is respectfully submitted that Wolf teaches away from the asserted combination. In particular, Wolf, at page 431, clearly teaches that “*static dispense . . . provide more uniform coatings that if the wafer is rotating.*” The teachings of Yoshihara and Rodrigues, in contrast, are limited to resist application techniques in which the resist is dispensed on a wafer while the wafer is rotating. Therefore, the portion of Wolf upon which the Office relies teaches away from the subject matter disclosed in both Yoshihara and Rodrigues.

Moreover, Rodrigues teaches that by dispensing photoresist as the speed at which a wafer is rotated is being slowed down, less resist is wasted than if the resist were dispensed while the

wafer is rotated at a constant speed, as in the method of Yoshihara. Col. 5, lines 48-65. Thus, Rodrigues teaches away from the method of Yoshihara.

Second, in view of the facts that Wolf teaches away from any combination with teachings from either Yoshihara or Rodrigues, it is not understood how one of ordinary skill in the art could have been motivated to combine the “static dispense” teachings of Wolf with the “dynamic dispense” teachings Yoshihara and Rodrigues. Nor is it understood how one of ordinary skill in the art could have been motivated to combine the teachings of Yoshihara and Rodrigues when Rodrigues clearly teaches the undesirability of dispensing resist while a wafer is being rotated at a constant speed, as disclosed in Yoshihara. In fact, it is submitted that the only way in which one of ordinary skill in the art would have been motivated to combine the teachings of Yoshihara, Rodrigues, and Wolf in the manner that has been asserted would have been through improper hindsight reliance upon the subject matter disclosed and claimed in the above-referenced application.

In view of the foregoing, it is clear that the teachings of Yoshihara, Rodrigues, and Wolf cannot be combined in such a way as to establish a *prima facie* case of obviousness against any of claims 1-4, 7-11, 14-16, or 20-32. Thus, under 35 U.S.C. § 103(a), the subject matter recited in each of these claims is allowable over the combined teachings of Yoshihara, Rodrigues, and Wolf. Accordingly, the 35 U.S.C. § 103(a) rejections of claims 1-4, 7-11, 14-16, 20-32 should be withdrawn.

CONCLUSION

It is respectfully submitted that each of claims 1-4, 7-11, 14-16, and 20-32 is allowable. An early notice of the allowability of each of these claims is respectfully solicited, as is an indication that the above-referenced application has been passed for issuance. If any issues preventing allowance of the above-referenced application remain which might be resolved by way of a telephone conference, the Office is kindly invited to contact the undersigned attorney.

Respectfully submitted,



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